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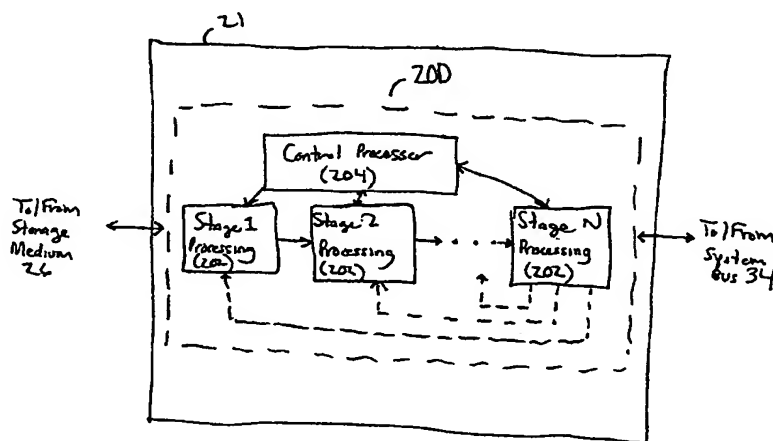
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MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG,  
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(54) Title: INTELLIGENT DATA STORAGE AND PROCESSING USING FPGA DEVICES



(57) Abstract: A data storage and retrieval device and method is disclosed. The device includes at least one magnetic storage medium configured to store target data and at least one re-configurable logic device comprising an FPGA coupled to the at least one magnetic storage medium and configured to read a continuous stream of target data therefrom, having been configured with a template or as otherwise desired to fit the type of search and data being searched. The re-configurable logic device is configured to receive at least one search inquiry in the form of a data key and to determine a match between the data key and the target data as it is being read from the at least one magnetic storage medium. This device and method can perform a variety of searches on the target data including without limitation exact and approximate match searches, sequence match searches, image match searches and data reduction searches. This device and method may be provided as part of a stand-alone computer system, embodied in a network attached storage device, or can otherwise be provided as part of a computer LAN or WAN. In addition to performing search and data reduction operations, this device may also be used to perform a variety of other processing operations including encryption, decryption, compression, decompression, and combinations thereof.



GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US2004/016398

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 7 G06F17/30 G06F15/78

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, INSPEC, IBM-TDB

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	HOLLAAR L A: "HARDWARE SYSTEMS FOR TEXT INFORMATION RETRIEVAL" PROCEEDINGS OF THE ANNUAL INTERNATIONAL ACM SIGIR CONFERENCE ON RESEARCH AND DEVELOPMENT IN INFORMATION RETRIEVAL, XX, XX, 6 June 1983 (1983-06-06), pages 3-9, XP000747642	1-4, 7, 12-15, 17, 18, 23, 28
Y	page 5, column 1, line 15 - page 6, column 1, line 6 page 6, column 2, line 24 - page 7, column 1, line 49 ----- -/--	5, 6, 8-11, 19-22, 24-27, 65-72

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

### \* Special categories of cited documents:

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US2004/016398

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	COMPTON, K., HAUCK, S.: "Configurable Computing: A Survey of Systems and Software" TECHNICAL REPORT, NORTHWESTERN UNIVERSITY, DEPT. OF ECE, 1999, XP002315148 USA	29-38
A	the whole document	39-64
X	SCHMIT H: "Incremental reconfiguration for pipelined applications" FIELD-PROGRAMMABLE CUSTOM COMPUTING MACHINES, 1997. PROCEEDINGS., THE 5TH ANNUAL IEEE SYMPOSIUM ON NAPA VALLEY, CA, USA 16-18 APRIL 1997, LOS ALAMITOS, CA, USA, IEEE COMPUT. SOC, US, 16 April 1997 (1997-04-16), pages 47-55, XP010247467 ISBN: 0-8186-8159-4 the whole document	39-64
X	ANONYMOUS: "Method for Allocating Computer Disk Space to a File of Known Size" IBM TECHNICAL DISCLOSURE BULLETIN, vol. 27, no. 10B, 1 March 1985 (1985-03-01), pages 6260-6261, XP002315149 New York, US the whole document	86-97
Y	EP 0 911 738 A (CALLUNA TECH LTD) 28 April 1999 (1999-04-28)	5, 6, 19-22, 1-4, 17, 18, 29-64
A	the whole document	
Y	NUNEZ J L ET AL: "The X-MatchLITE FPGA-based data compressor" EUROMICRO CONFERENCE, 1999. PROCEEDINGS. 25TH MILAN, ITALY 8-10 SEPT. 1999, LOS ALAMITOS, CA, USA, IEEE COMPUT. SOC, US, 8 September 1999 (1999-09-08), pages 126-132, XP010352239 ISBN: 0-7695-0321-7	8-11, 24-27, 65-72
A	the whole document	1, 5, 6, 17, 21, 22, 29-64
X	WO 01/22425 A (SEAGATE TECHNOLOGY LLC) 29 March 2001 (2001-03-29) the whole document	1-15, 17-28, 65-72
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# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US2004/016398

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>GUNTHER B ET AL: "Assessing document relevance with run-time reconfigurable machines"</p> <p>FPGAS FOR CUSTOM COMPUTING MACHINES, 1996. PROCEEDINGS. IEEE SYMPOSIUM ON NAPA VALLEY, CA, USA 17-19 APRIL 1996, LOS ALAMITOS, CA, USA, IEEE COMPUT. SOC, US, 17 April 1996 (1996-04-17), pages 10-17, XP010206387</p> <p>ISBN: 0-8186-7548-9</p> <p>the whole document</p>	<p>1,2,7, 11,17, 18,23, 27,28</p>
A	<p>HAUCK, S., AGARWAL, A.: "Software Technologies for Reconfigurable Systems"</p> <p>TECHNICAL REPORT, NORTHWESTERN UNIVERSITY, DEPT. OF ECE, 1996, XP002315150</p> <p>USA</p> <p>abstract</p> <p>* paragraph 5.0: Software Support for Reconfigurable Computing *</p> <p>* paragraph 6.0: Software Support for Run-Time Reconfigurability *</p>	<p>29-38</p>
A	<p>EBELING C ET AL: "RaPiD-reconfigurable pipelined datapath"</p> <p>FIELD-PROGRAMMABLE LOGIC. SMART APPLICATIONS, NEW PARADIGMS AND COMPILERS. 6TH INTERNATIONAL WORKSHOP ON FIELD-PROGRAMMABLE LOGIC AND APPLICATIONS, FPL '96 PROCEEDINGS SPRINGER-VERLAG BERLIN, GERMANY, 23 September 1996 (1996-09-23), pages 126-135, XP002315151</p> <p>DARMSTADT, GERMANY</p> <p>ISBN: 3-540-61730-2</p> <p>the whole document</p>	<p>39-64</p>
A	<p>EP 0 851 358 A (SUN MICROSYSTEMS INC)</p> <p>1 July 1998 (1998-07-01)</p> <p>abstract</p> <p>figures 1-6</p>	<p>1,7,17, 18</p>
A	<p>US 3 824 375 A (GROSS W ET AL)</p> <p>16 July 1974 (1974-07-16)</p> <p>abstract</p> <p>column 2, line 24 - column 2, line 61</p>	<p>1,2,16, 17</p>
A	<p>PRAMANIK S ET AL: "A HARDWARE PATTERN MATCHING ALGORITHM ON A DATAFLOW"</p> <p>COMPUTER JOURNAL, OXFORD UNIVERSITY PRESS, SURREY, GB, vol. 28, no. 3, 1 July 1985 (1985-07-01), pages 264-269, XP000743646</p> <p>ISSN: 0010-4620</p> <p>the whole document</p>	<p>1,2,17</p>
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# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US2004/016398

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 819 290 A (FUJITA ET AL) 6 October 1998 (1998-10-06) abstract column 1, line 32 - column 2, line 44 figures 1,2,5-8	86-97
A	----- US 5 339 411 A (HEATON, JR. ET AL) 16 August 1994 (1994-08-16) the whole document -----	86-97

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US2004/016398

## Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☒ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:  
1-15, 17-64, 86-97
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

### Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☒ No protest accompanied the payment of additional search fees.

**FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210**

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-15,17-28, 65-72

Device and method of manipulating data passing to or from a mass storage medium  
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2. claim: 16

A programmable logic device configured to receive in parallel data streams from a plurality of heads belonging to a plurality of disks in a disk system.  
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3. claims: 29 - 38

Method for selecting a template for programming a programmable logic device  
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4. claims: 39 - 64

Data processing system comprising a plurality of processing stages implemented on a programming logic device  
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5. claims: 73 - 85

Data storage medium, method of reading data and disk drive system comprising magnetically stored data for subsequent retrieval by a magnetic head  
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6. claims: 86 -97

Method of storing data depending on the file size  
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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No  
PCT/US2004/016398

Patent document cited in search report		Publication date		Patent family member(s)	Publication date
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